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D'APPOLONIA CONSULTING ENGINEERS INC PITTSBURGH PA

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NATIONAL DAM INSPECTION PROGRAM. GALION BAY DAM (NDI ID NUMBER --ETC(U)

DACW31-79-C-0014

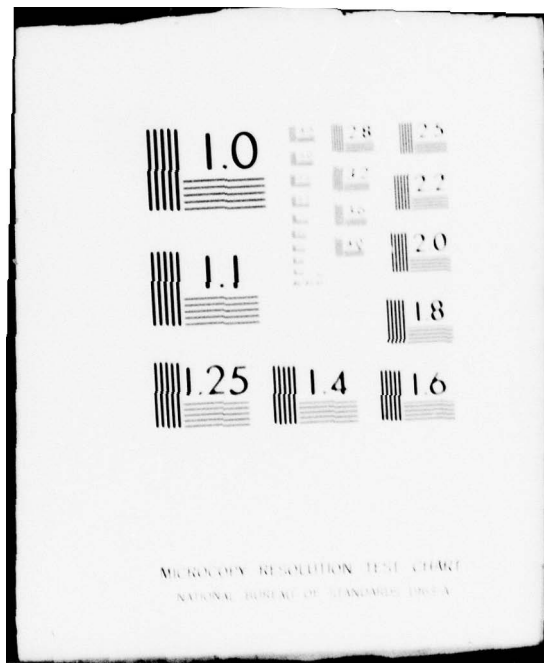
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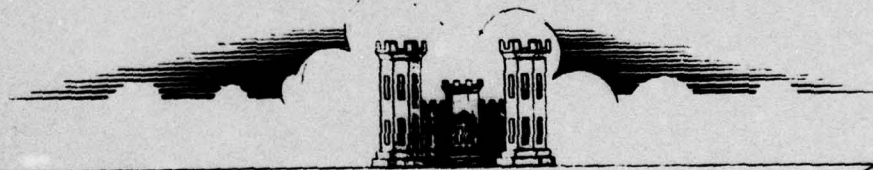
PENNSYLVANIA

GALION BAY DAM
(LAKE RENE)
NDI I.D. NO: PA-747
DER I.D. NO: 17-107

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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DEPARTMENT OF THE ARMY
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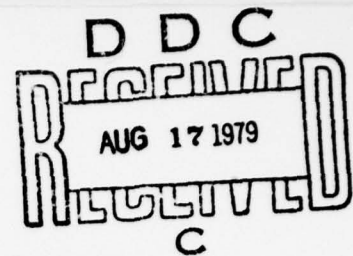
BY
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10 DUFF ROAD
PITTSBURGH, PA. 15235
JUNE 1979

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Department of the Army, Office of Chief of Engineers, Washington, D.C. 20314.

The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon visual observations and review of available data. Detailed investigation and analyses involving topographic mapping, subsurface investigations, material testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the inspection is intended to identify any need for such studies which should be performed by the owner.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of the dam depends on numerous and constantly changing internal and external factors which are evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The assessment of the conditions and recommendations was made by the consulting engineer in accordance with generally and currently accepted engineering principles and practices.

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3. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.



Lawrence D. Andersen
Lawrence D. Andersen, P.E.

June 25, 1979
Date

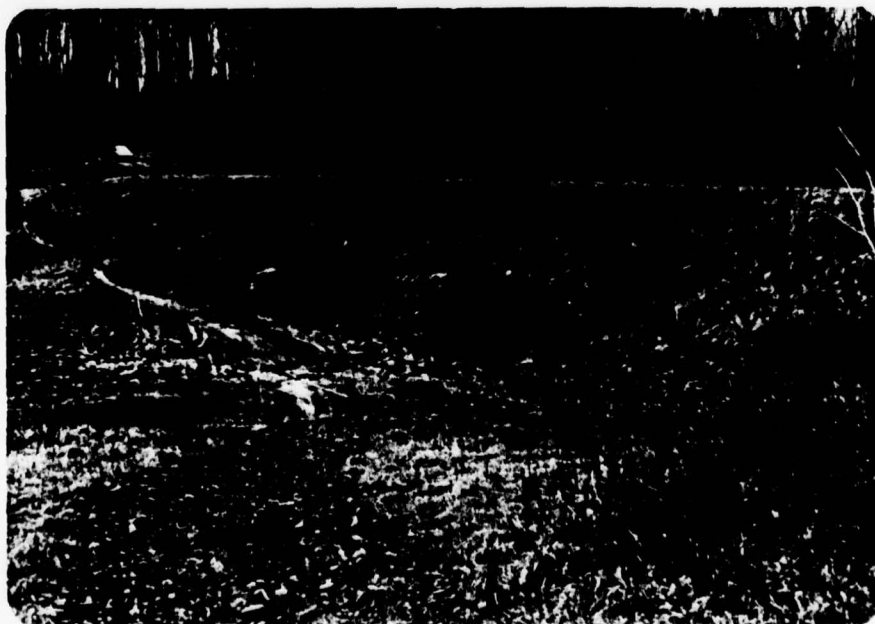
Approved by:

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer
27 July 1979
Date

GALION BAY DAM
NDI I.D. NO. PA-747
APRIL 3, 1979



Upstream Face



Downstream Face

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
GALION BAY DAM
NDI I.D. NO. PA-426
DER I.D. NO. 17-107

SECTION 1
PROJECT INFORMATION

1.1 General

a. Authority. The inspection was performed pursuant to the authority granted by The National Dam Inspection Act, Public Law 92-367, to the Secretary of the Army, through the Corps of Engineers, to conduct inspections of dams throughout the United States.

b. Purpose. The purpose of this inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project

a. Dam and Appurtenances. Galion Bay Dam consists of an earth embankment approximately 400 feet long with a maximum height of 37 feet from the downstream invert of the outlet conduit and a crest width of 20 feet. Galion Bay Dam is one of the three dams which impound Lake Rene. The other two dams are Wolf Creek Dam, located at the west end of Lake Rene, and Lake Rene Dam, located on the east side of the reservoir. Lake Rene Dam, which was constructed in 1955, was the original dam at the site. Galion Bay Dam and Wolf Creek Dam were constructed in 1971 in conjunction with the enlargement of Lake Rene.

The flood discharge facilities for Lake Rene consist of primary and emergency spillways associated with Galion Bay and Wolf Creek dams. The Galion Bay Dam flood discharge facilities are comprised of a drop inlet primary spillway located at the center of the embankment and an emergency spillway on the right abutment (looking downstream). The primary spillway structure consists of a single-stage reinforced concrete riser, a 36-inch-diameter reinforced concrete conduit, and a plunge pool at the downstream end of the outlet pipe. The emergency spillway is a 30-foot-wide trapezoidal earth channel excavated into the right abutment. The reservoir outlet pipe for the dam consists of a 15-inch steel pipe extending from the upstream toe of the dam to the drop inlet structure. Flow through the reservoir outlet is controlled by a manually operated sluice gate located in the drop inlet structure.

b. Location. The dam is located on Gravel Lick Run, a tributary of Sandy Lick Creek, immediately upstream from Gravel Lick Dam and three miles northeast of DuBois in Sandy Township, Clearfield County, Pennsylvania (Plate 1).

Downstream from the dam, Gravel Lick Run flows through a narrow and uninhabited valley for approximately 1/2 mile where it flows into Gravel Lick Dam reservoir. It is estimated that failure of Galion Bay Dam would result in the failure of the downstream dam and the combined discharge would cause large loss of life and property damage further downstream.

c. Size Classification. Intermediate (based on 6750 acre-feet storage capacity).

d. Hazard Classification. High.

e. Ownership. Treasure Lake of Pennsylvania, Inc. (address: Mr. James R. Farrer, Director of Development, Treasure Lake of Pennsylvania, Inc., P.O. Box 687, DuBois, Pennsylvania 15801).

f. Purpose of Dam. Recreation.

g. Design and Construction History. The dam was designed by R. M. Keddal and Associates, Inc., of Bethel Park, Pennsylvania, and Engineering Mechanics, Inc., of Pittsburgh, Pennsylvania, in 1969. The dam was constructed by Canton Development Company of DuBois, Pennsylvania, with completion in 1971.

h. Normal Operating Procedure. The reservoir is normally maintained at Elevation 1662.5, the uncontrolled primary spillway crest elevation, for both Wolf Creek and Galion Bay dams. The inflow occurring when the lake is at or above the primary spillway level is discharged through the primary and emergency spillways of Wolf Creek and Galion Bay dams.

1.3 Pertinent Data

a. Drainage Area 4.4 square miles

b. Discharge at Dam Site (cfs)

Maximum known flood at dam site	Unknown
Outlet conduit at maximum pool	20
Gated spillway capacity at maximum pool	N/A
Ungated spillway capacity at maximum pool	1453
Total spillway capacity at maximum pool	1453

c. Elevation (USGS Datum) (feet)

Top of dam	1670 (as designed)
Maximum pool	1670
Normal pool	1662.5
Upstream invert outlet works	1642.8
Downstream invert outlet works	1626+
Streambed at center line of dam	1626+
Maximum tailwater	Unknown

d. Reservoir Length (feet)

Normal pool level	10,000
Maximum pool level	10,000

e. Storage (acre-feet)

Normal pool level	3700
Maximum pool level	6750

Normal pool level	310
Maximum pool level	360

g. Dam

Type	Earth
Crest length	420 feet
Height	37 feet
Top width	20 feet
Side slopes	3H:1V both upstream and downstream slopes
Zoning	Yes
Impervious core	Yes
Cutoff	Yes
Grout curtain	No

h. Regulating Outlet

Type	15-inch reservoir outlet pipe
Length	50+ feet
Closure	Sluice gate at drop inlet structure
Access	Through drop inlet structure
Regulating facilities	Sluice gate

1. <u>Spillway</u>	<u>Primary</u>	<u>Emergency</u>
Type	Drop inlet	Trapezoidal earth channel
Length	18 feet	130 feet
Crest elevation	1662.5	1664.5
Gates	None	None
Upstream channel	Lake	Trapezoidal earth channel
Downstream channel	36-inch outlet conduit	Trapezoidal earth channel

SECTION 2 DESIGN DATA

2.1 Design

a. Data Available. The available information was provided by the Commonwealth of Pennsylvania, Department of Environmental Resources (PennDER).

(1) Hydrology and Hydraulics. The available information consists of design and freeboard hydrographs and associated flood routings.

(2) Embankment. Available information consists of design drawings, construction specifications, and limited engineering analyses for slope stability.

(3) Appurtenant Structures. Available information includes design drawings.

b. Design Features

(1) Embankment

- a. As designed, the dam (Plate 2) is a zoned embankment (Plate 3) with an impervious core extending through a cutoff trench to top of rock and an internal drainage system beneath the downstream slope. Two zones are identified. The first zone is an impervious zone and forms the core of the embankment. The second zone is a semi-impervious zone and constitutes the shell sections of the embankment. The impervious core zone is trapezoidal in cross section and starts at a level five feet below the crest of the dam and extends through the cutoff trench to the top of rock. The internal drainage system consists of a trench drain along the downstream toe of the embankment. The trench drain is shown to be equipped with a perforated pipe which discharges into the outlet works discharge channel .
- b. The dam was designed to have a 3H to 1V slope on both the upstream and downstream faces, except for the portion of the upstream slope below the bench level at Elevation 1658, which was designed to have a 5H to 1V slope.

- c. A design drawing (Plate 4) indicates that at least three borings were drilled for subsurface investigation. As shown on Plate 4, the boring logs only provide qualitative information.
- d. Plate 5 shows that a sewer pipe is located through each abutment beneath the embankment. The drawing indicates that the sewer pipes are encased in concrete and are equipped with concrete cutoff collars.

(2) Appurtenant Structures. The appurtenant structures of the dam consist of a drop inlet primary spillway and emergency spillway. The primary spillway structures include a single-stage reinforced concrete riser and a 36-inch-diameter reinforced concrete conduit through the embankment terminating at a plunge pool at the downstream toe of the dam (Plates 6 and 7). A 15-inch steel pipe from the upstream toe of the dam discharging into the drop inlet structure constitutes the reservoir outlet facilities. Flow through the reservoir outlet pipe is controlled by a sluice gate located in the drop inlet structure. The spillway conduit through the embankment is encased in concrete and is equipped with reinforced concrete cutoff collars.

The emergency spillway is a trapezoidal earth channel excavated into the right abutment (Plate 2). The bottom width of the trapezoidal channel is 30 feet with side slopes of 2H to 1V. A 30-foot-wide level section located at Elevation 1664.5 in line with the axis of the embankment constitutes the control section of the spillway.

c. Design Data

(1) Hydrology and Hydraulics. An undated report entitled, Galion Bay Dam for Treasure Lake of Pennsylvania, Inc., prepared by R. M. Keddal and Associates, Inc., and Engineering Mechanics, Inc., includes the available hydrology and hydraulics analyses for the dam. It appears that although some calculations were performed according to the Soil Conservation Service (SCS) procedures, the emergency spillways of Galion Bay and Wolf Creek dams which constitute the flood discharge facilities for Lake Rene were sized according to Pennsylvania design criteria in effect at the time ("C" curve). The combined discharge capacity of Galion Bay and Wolf Creek dams spillways was reported to be 5000 cfs with no freeboard.

(2) Embankment. Available information indicates that, apparently, the dam design was based on very limited engineering analyses. The engineer's report includes a slope stability analysis based on assumed soil strength parameters. The assumed effective soil strength parameters were internal friction angle, 25 degrees; cohesion, 200 pounds per square foot (psf). The computed factors of safety were: 2.1 for the downstream slope under steady-state seepage conditions and 1.2 for the

upstream slope under rapid drawdown conditions. No further engineering analysis or reference to such information was found in the available information.

(3) Appurtenant Structures. It appears that the design of the appurtenant structures was based on standard SCS designs.

2.2 Construction. Available information consists of various construction progress reports. No as-built drawings were available. To the extent that can be determined, the construction of the dam was in conformance with the design drawings. No unusual construction difficulties were reported. The dam was constructed under the supervision of Engineering Mechanics, Inc.'s field representative.

Available information indicates no post-construction changes.

2.3 Operation. No records of operation have been kept.

2.4 Other Investigations. None reported.

2.5 Evaluation

a. Availability. Available information was obtained from PennDER.

b. Adequacy

(1) Hydrology and Hydraulics. Available information indicates that the spillway was designed in conformance with Pennsylvania spillway design criteria applicable at the time of the design. Only the design capacity is reported, therefore, this information is not adequate to assess the conformance of the spillway capacity in accordance with current spillway design criteria.

(2) Embankment. The dam was apparently designed based on limited subsurface investigation and engineering analyses. No reference was found to indicate any field or laboratory testing or detailed engineering analyses were performed.

(3) Appurtenant Structures. Review of the design drawings indicates that as designed no significant design deficiencies existed that should affect the overall performance of the appurtenant structures.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The on-site inspection of Galion Bay Dam consisted of:

1. Visual inspection of the embankment, abutments, and embankment toe.
2. Visual examination of the emergency spillway and exposed portions of the primary spillway.
3. Observation of factors affecting the runoff potential of the drainage basin.
4. Evaluation of downstream hazard potential.

The specific observations are illustrated in Plate 8 and in the photographs in Appendix C.

b. Embankment. The general inspection of the embankment consisted of searching for indications of structural distress, such as cracks, subsidence, bulging, wet areas, seeps and boils, and observing general maintenance conditions, vegetative cover, erosion, and other surficial features.

In general, the condition of the dam is considered to be good. One wet area was found along the toe of the dam near the left abutment. No measurable seepage was found to be associated with this wet area. Riprap on the upstream face was found to be partially deteriorated; however, it is still providing adequate erosion protection.

The top of the embankment was surveyed relative to the pool level on the date of inspection, which was estimated at Elevation 1662.6 and the lowest area on the crest of the embankment was found to be within 0.1 foot above the design elevation of 1670. The dam crest profile is illustrated on Plate 9.

c. Appurtenant Structures. The appurtenant structures were examined for deterioration or other signs of distress or obstructions that would limit flow. While the primary spillway structures were found to be in good condition, lack of adequate riprap on the embankment side of the emergency spillway discharge channel raised some concern about potential erosion of the embankment during large flows through the emergency spillway. Therefore, installation of adequate erosion protection in the emergency spillway channel is recommended.

d. Reservoir Area. A map review indicates that the watershed is predominantly covered with woodlands. A small portion of the watershed has been strip mined. A review of the regional geology (Appendix E) indicates that the reservoir slopes are not likely to be susceptible to massive landslides which would affect the storage volume of the reservoir.

e. Downstream Channel. Downstream from the dam, a stream flows approximately 1/2 mile south where it discharges into the Gravel Lick Dam reservoir. Further description of the downstream conditions is included in Section 1.2b.

3.2 Evaluation. The condition of the dam is considered to be good. The present extent of the wet area along the toe of the dam near the left abutment does not appear to be affecting the stability of the embankment at this time. Installation of additional riprap on the embankment side of the emergency spillway discharge channel is recommended to avoid embankment erosion during large flows through the emergency spillway.

SECTION 4 OPERATIONAL FEATURES

4.1 Procedure. There are no formal operating procedures for the dam. The reservoir is normally maintained at the crest level of the primary spillways for this dam and Wolf Creek dam with excess inflow discharging over the uncontrolled primary or emergency spillways.

4.2 Maintenance of the Dam. The maintenance of the dam is considered to be fair. The downstream face of the dam is covered with partially established grass and appears to be mowed occasionally. Minor erosion rills were observed in areas without adequate grass cover.

4.3 Maintenance of Operating Facilities. The only operational feature of the dam is the reservoir outlet sluice gate which is operated by a hoist located on the drop inlet structure. The reservoir outlet pipe sluice gate was operated and observed to be functional.

4.4 Warning System. No formal warning system exists for the dam. Telephone communication facilities are available via residences in the vicinity of the dam.

4.5 Evaluation. While the maintenance condition of the dam is considered to be fair, the maintenance condition of the operating facilities is assessed to be good. Installation of adequate riprap in the emergency spillway discharge channel is recommended.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features

a. Design Data. Galion Bay Dam is one of three dams which impound Lake Rene. Lake Rene has a watershed of 4.4 square miles and a lake area of 310 acres at normal pool elevation. The flood discharge facilities of Lake Rene consist of the primary and emergency spillways of Galion Bay and Wolf Creek dams. The combined capacity of the spillways of Galion Bay and Wolf Creek dams was determined to be 5300 cfs with no freeboard.

b. Experience Data. As previously stated, Galion Bay Dam is classified as an intermediate dam in the high hazard category. Under the recommended criteria for evaluating emergency spillway discharge capacity, such impoundments are required to pass full PMF.

The PMF inflow hydrograph for the reservoir was determined using the Dam Safety Version of the HEC-1 computer program developed by the Hydrologic Engineering Center of the U.S. Army, Corps of Engineers. Data used for the computer analysis are presented in Appendix D. The PMF inflow hydrograph was found to have a peak flow of 10,851 cfs. The computer input and summary of computer output are also included in Appendix D.

c. Visual Observations. On the date of inspection, no conditions were observed that would indicate that the capacity of the spillways of Galion Bay and Wolf Creek dams would be significantly reduced in the event of a flood.

d. Overtopping Potential. Various percentages of PMF inflow hydrograph were routed through the reservoir. It was found that the spillways of Galion Bay and Wolf Creek dams can pass 90 percent PMF without overtopping the embankment. For 100 percent PMF, a low spot on the crest of Galion Bay Dam, which was found to be 0.1 foot above the design crest elevation of 1670, would be overtopped for a duration of two hours with a maximum depth of 0.2 foot. It is estimated that overtopping of the dam by a maximum of 0.2 foot would not constitute a significant potential for embankment erosion.

e. Spillway Adequacy. Since the flood discharge facilities of Lake Rene cannot pass the recommended spillway design of 100 percent PMF without overtopping the embankment, the spillway capacity is rated to be inadequate.

SECTION 6 STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations

(1) Embankment. As discussed in Section 3, the field observations did not reveal any signs of distress that would significantly affect the stability of the dam at this time.

(2) Appurtenant Structures. Lack of adequate riprap on the embankment (left) side of the emergency spillway discharge channel raises some concern as to the potential for erosion of the embankment during large flows through the emergency spillway. Therefore, installation of additional erosion protection on the embankment side of the emergency spillway discharge channel is recommended.

b. Design and Construction Data

(1) Embankment. Available information indicates that the stability of the embankment was analyzed for steady-state seepage and rapid drawdown conditions based on assumed soil strength parameters. The factor of safety was reported to be 2.1 under steady-state seepage stability of the downstream slope and 1.2 for the rapid drawdown condition of the upstream slope. Available information includes no data on the classification or compaction characteristics of the embankment soils. Therefore, adequacy of the assumed soil strength parameters could not be assessed.

(2) Appurtenant Structures. Review of the design drawings indicates that there are no apparent structural deficiencies that would significantly affect the performance of the appurtenant structures.

c. Operating Records. There are no operating records kept for the dam.

d. Post-Construction Changes. None reported.

e. Seismic Stability. The dam is located in Seismic Zone 1, and based on visual observations the static stability of the dam is considered to be adequate. Therefore, based on the recommended criteria for evaluation of seismic stability of dams, the structure is presumed to present no hazard from earthquakes.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Assessment. Visual observations indicate that Galion Bay Dam is in good condition. No conditions were observed that would significantly affect the overall performance of the structure at this time.

The swampy area observed at the toe area near the left abutment is not considered to be serious relative to the overall performance of the dam at this time. However, this area should be periodically observed to determine if the conditions are changing. A lack of adequate erosion protection on the embankment side of the emergency spillway discharge channel raises some concern as to the potential for erosion of the embankment during large flows through the emergency spillway. Therefore, adequate erosion protection should be provided.

The flood discharge capacity of Lake Rene via the spillways of Galion Bay and Wolf Creek dams was found to be 90 percent PMF and is therefore classified to be inadequate according to the recommended criteria.

b. Adequacy of Information. Available information in conjunction with visual observations and the previous experience of the inspectors are considered to be sufficient to make a reasonable assessment of the condition of the dam.

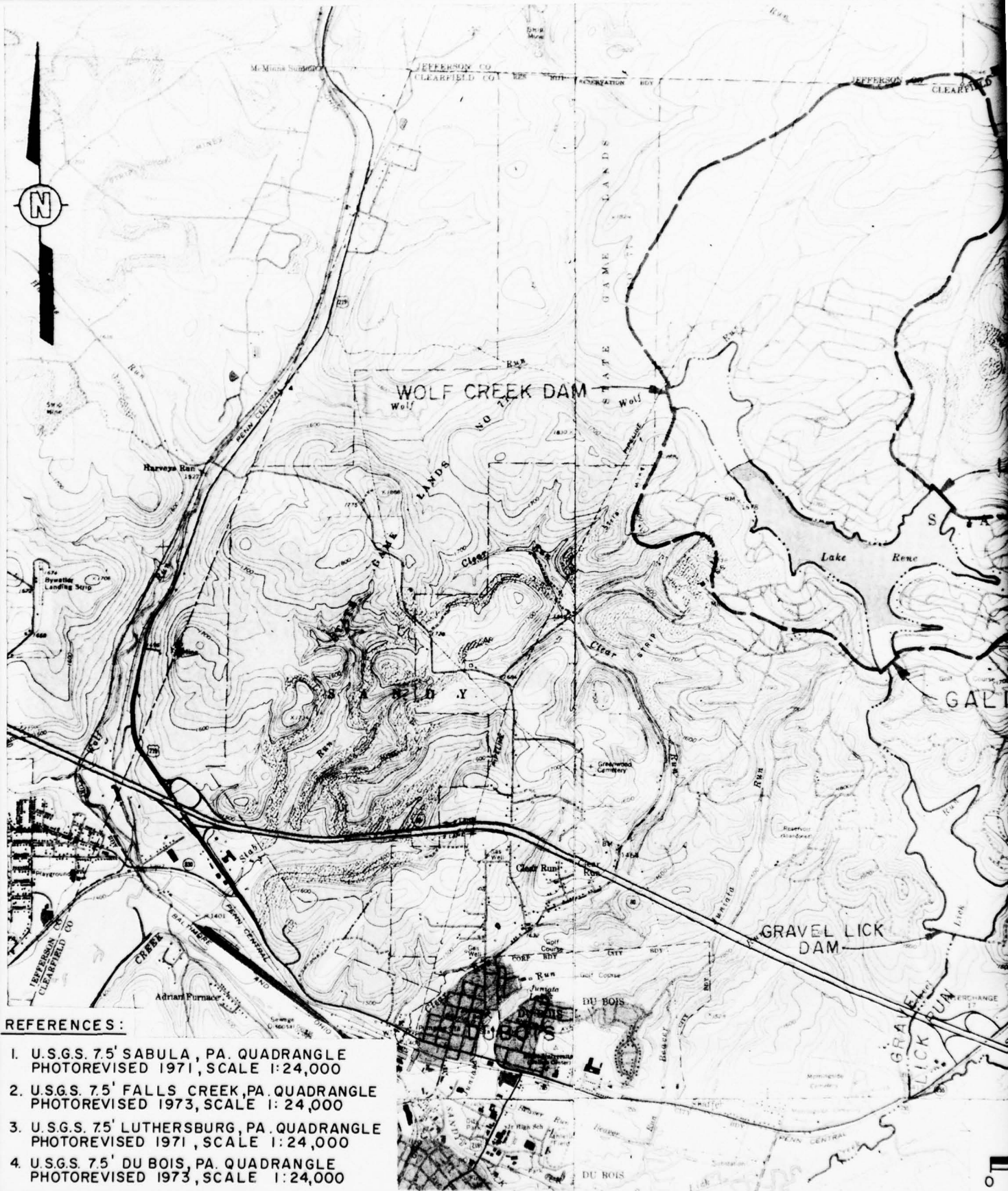
c. Urgency. The following recommendations should be implemented immediately or on a continuing basis.

d. Necessity for Additional Data. No additional data are considered required at this time.

7.2 Recommendations/Remedial Measures. It is recommended that:

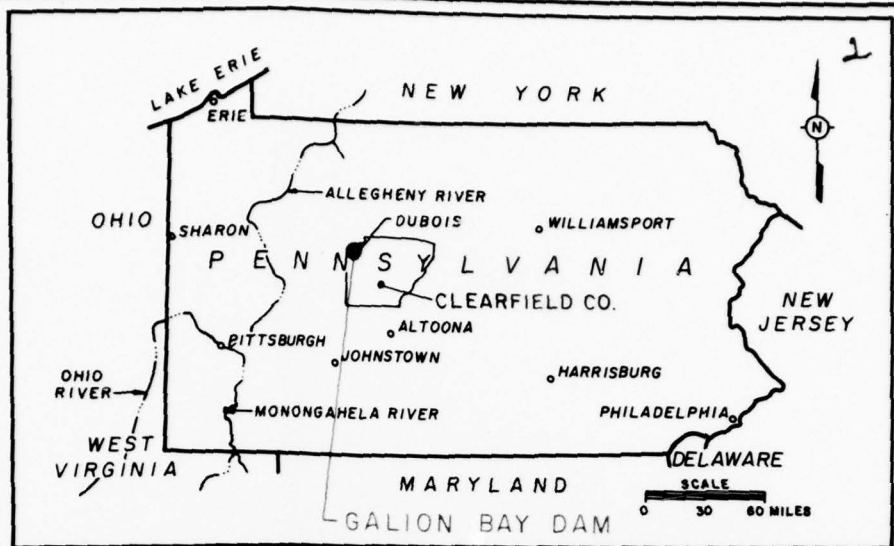
1. Adequate erosion protection should be provided on the embankment (left) side of the emergency spillway discharge channel to protect the embankment from eroding during flows through the emergency spillway.
2. Around-the-clock surveillance should be provided during unusually heavy runoff and a formal warning system should be developed to alert downstream residents in the event of emergencies.
3. The dam and appurtenant structures should be inspected regularly and necessary maintenance should be performed.

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 APPROVED BY MC 6-4-77



REFERENCES:

1. U.S.G.S. 7.5' SABULA, PA. QUADRANGLE PHOTOREVISED 1971, SCALE 1:24,000
2. U.S.G.S. 7.5' FALLS CREEK, PA. QUADRANGLE PHOTOREVISED 1973, SCALE 1:24,000
3. U.S.G.S. 7.5' LUTHERSBURG, PA. QUADRANGLE PHOTOREVISED 1971, SCALE 1:24,000
4. U.S.G.S. 7.5' DU BOIS, PA. QUADRANGLE PHOTOREVISED 1973, SCALE 1:24,000



KEY PLAN

LAKE RENE DAM

APPROXIMATE
WATERSHED AREA

GALION BAY DAM

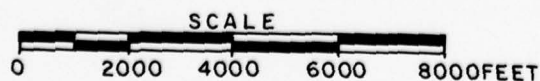
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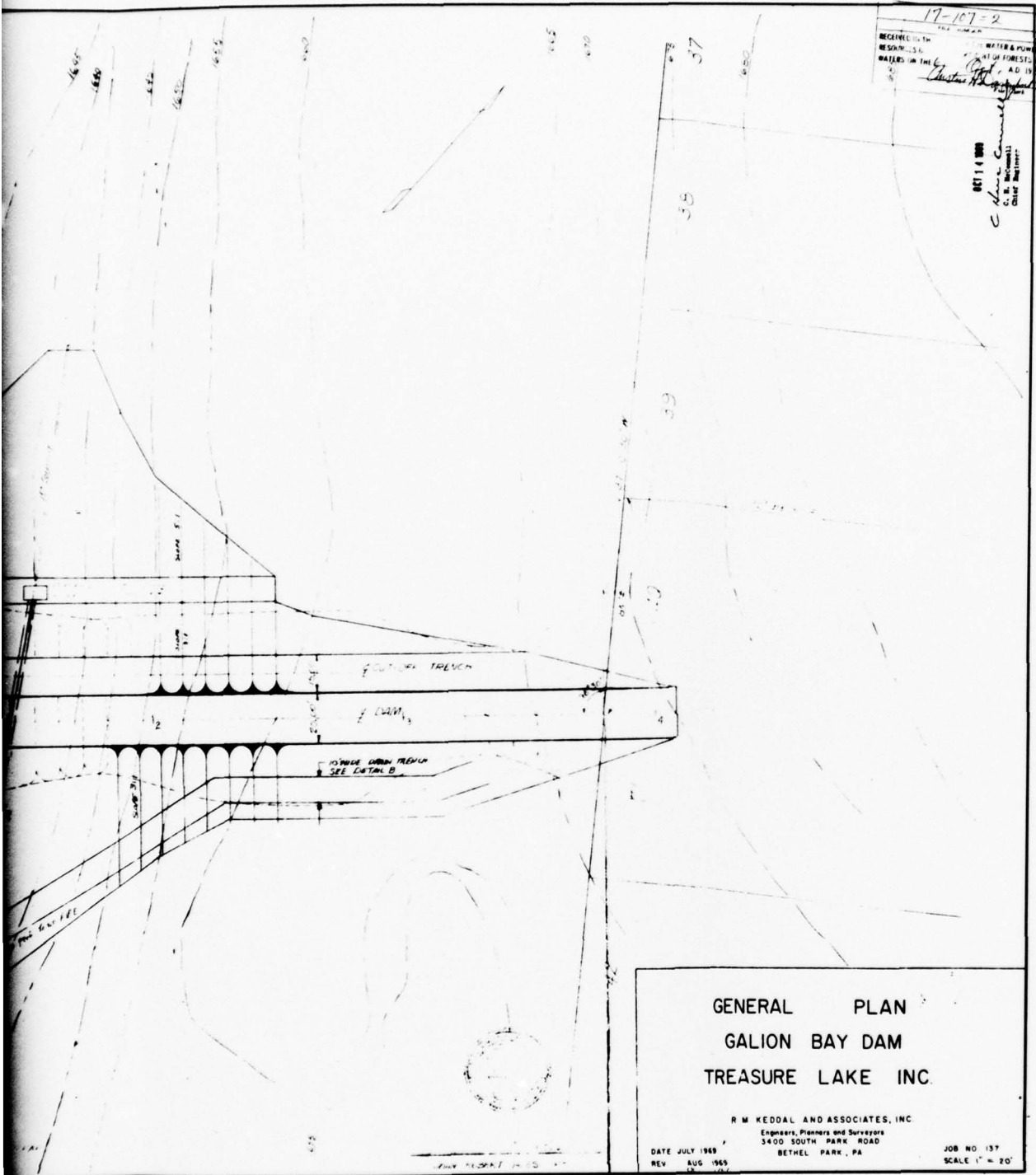
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PLATE I

GALION BAY DAM
VICINITY, FLOOD PLAIN & WATERSHED MAP



D'APPOLONIA



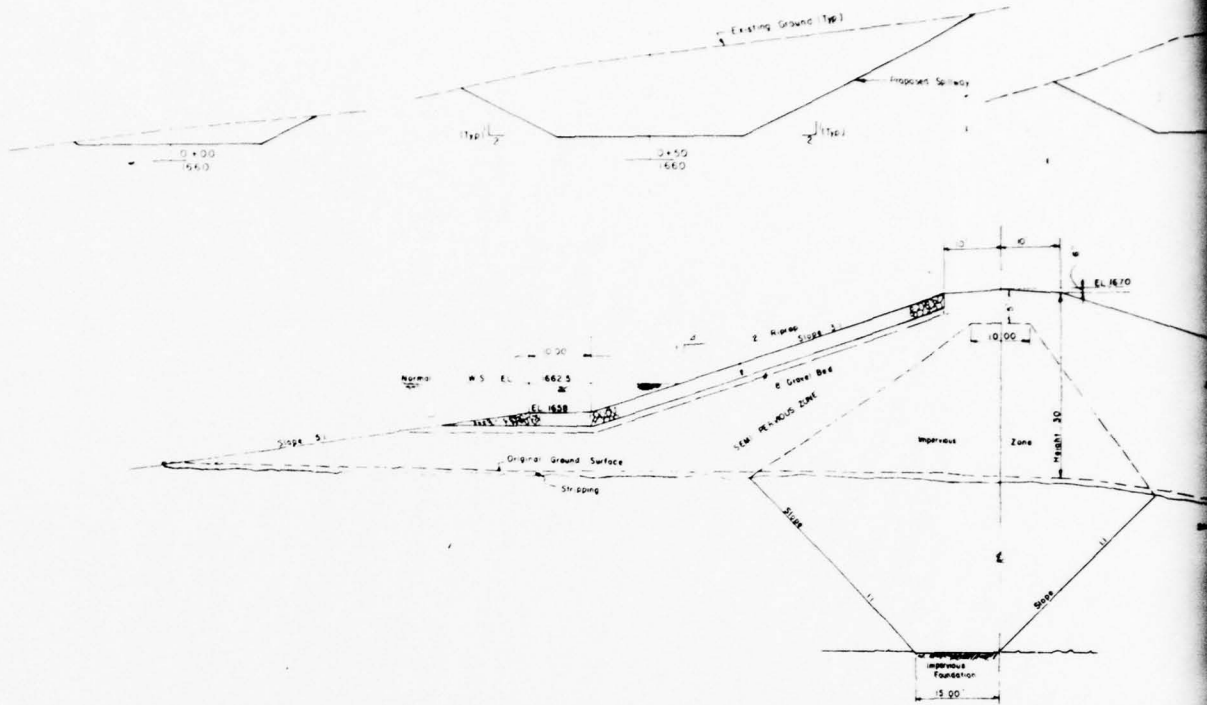
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WASHINGTON, D.C.
JUL 15 1968
C. H. McDaniel
Chief Engineer

GENERAL PLAN
GALION BAY DAM
TREASURE LAKE INC.

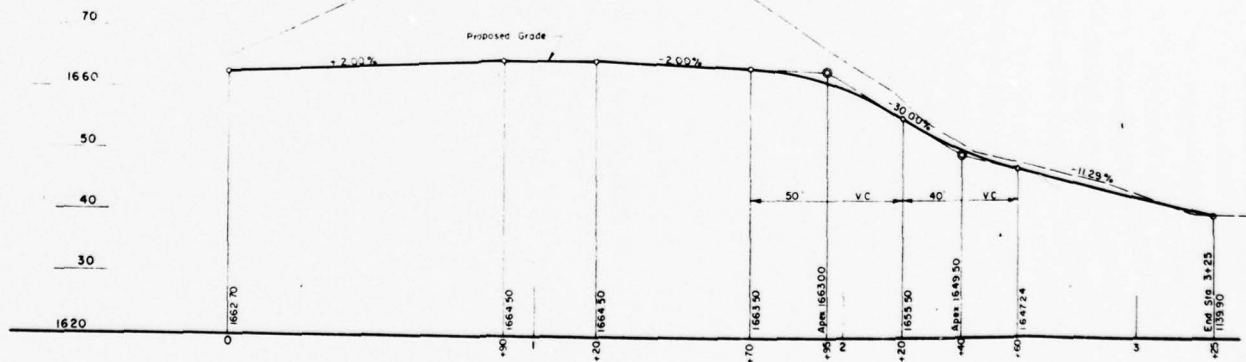
R. M. KEDDAL AND ASSOCIATES, INC.
Engineers, Planners and Surveyors
3400 SOUTH PARK ROAD
BETHEL PARK, PA.
DATE JULY 1968
REV AUG 1968
JOB NO. 137
SCALE 1" = 20'

PLATE 2

D'APPOLONIA



MAXIMUM SECTION TAKEN AT
STATION 1+95
SCALE 1" = 20' HOR. 1" = 10' VERT.



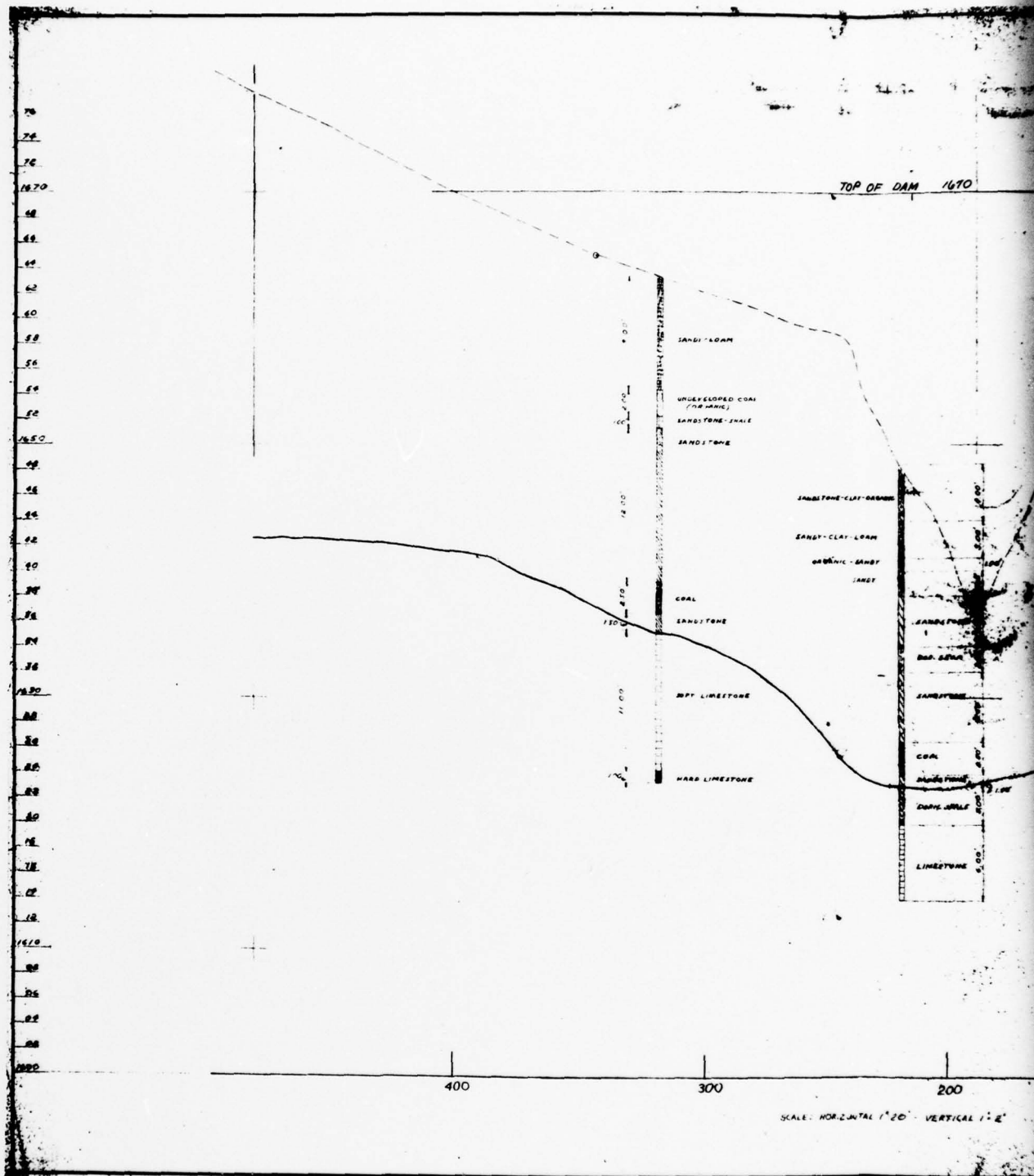
PROFILE EMERGENCY SPILLWAY - GALION BAY

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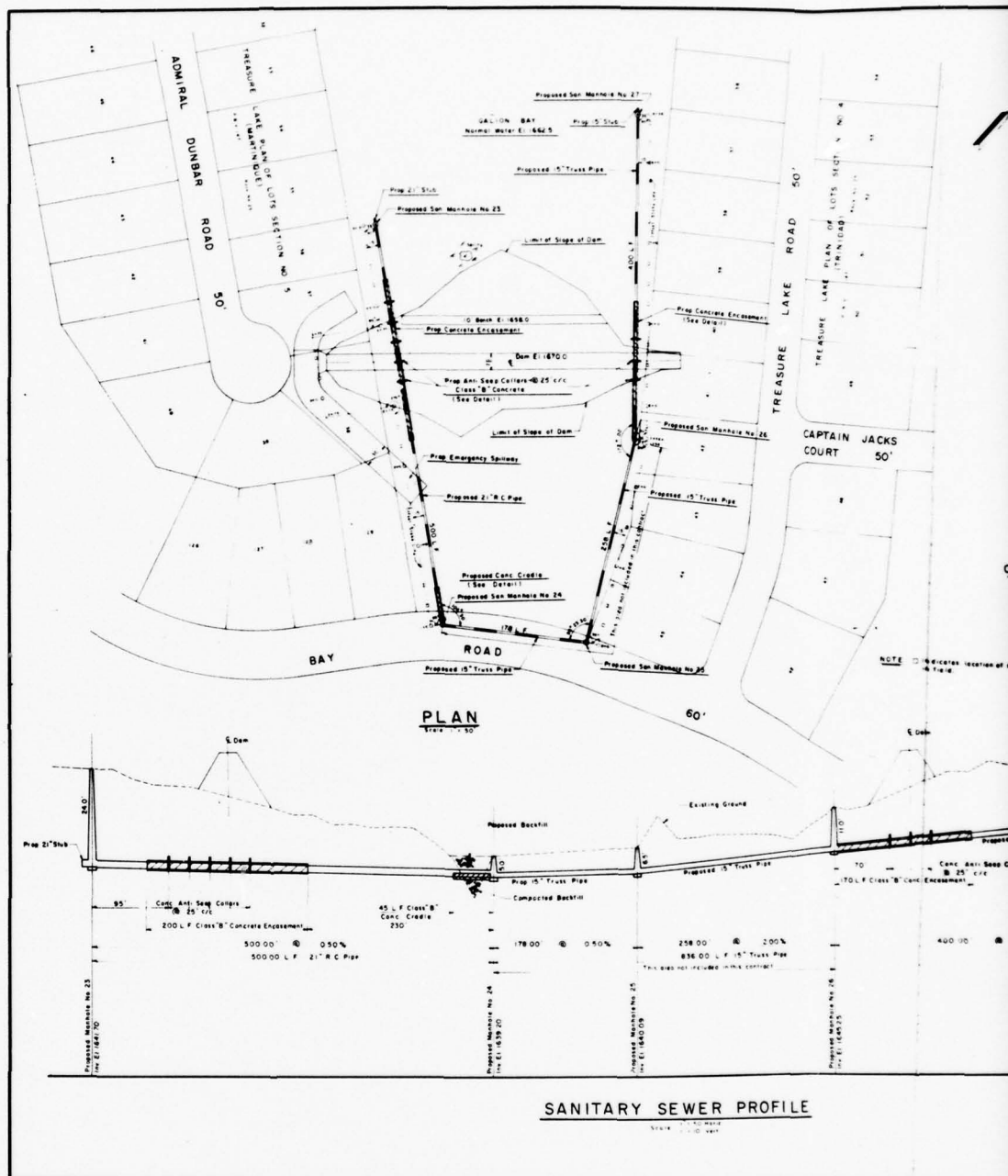


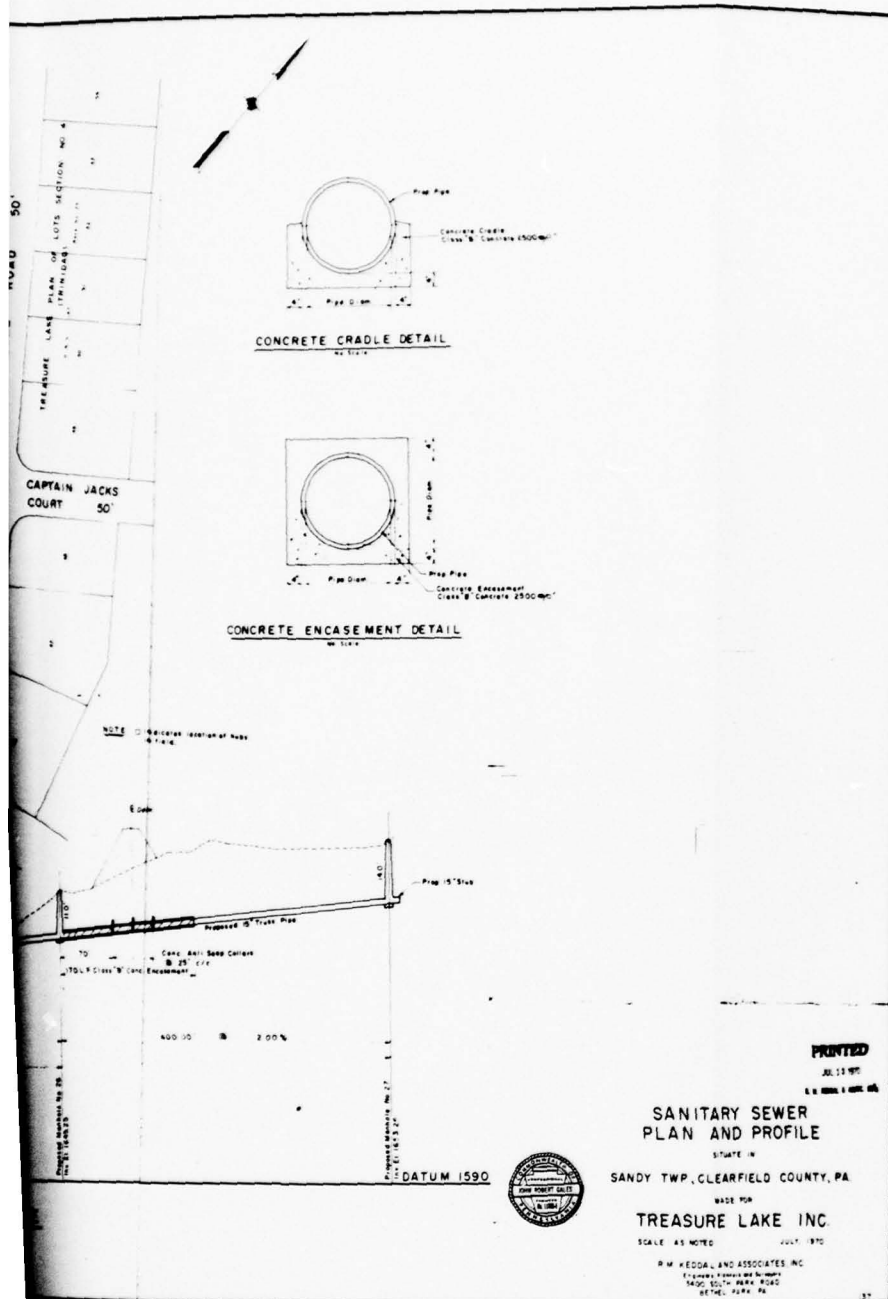
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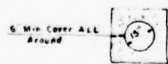
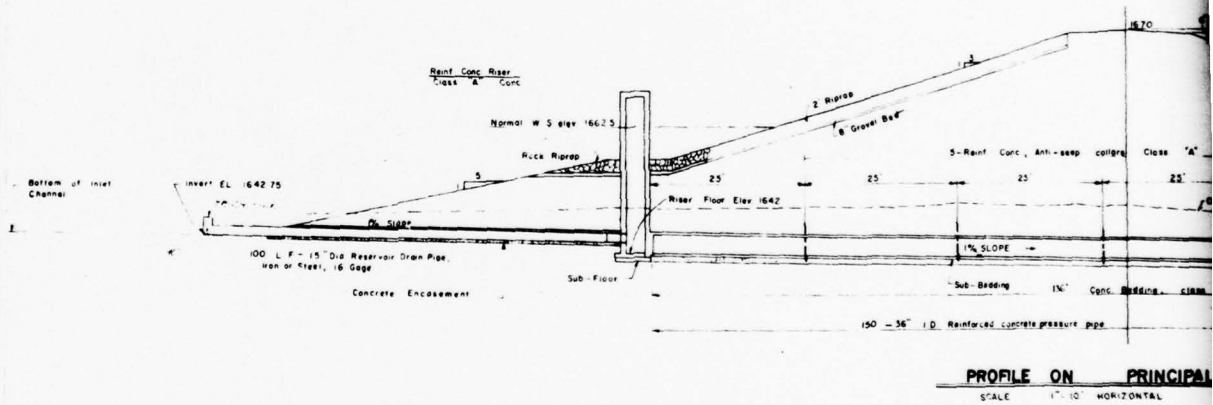
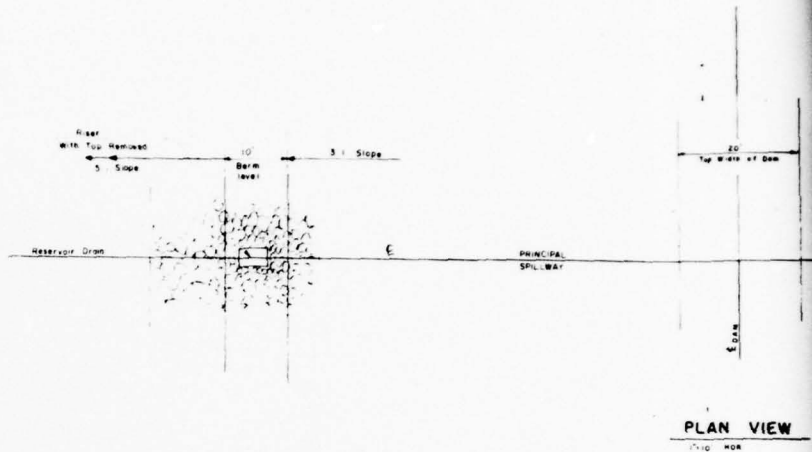


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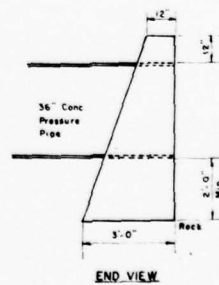
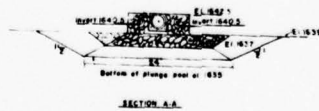




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	5-22-79	APPROVED BY	6-4-79		



CONCRETE ENCASEMENT

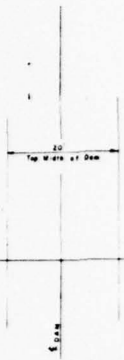


END WALL

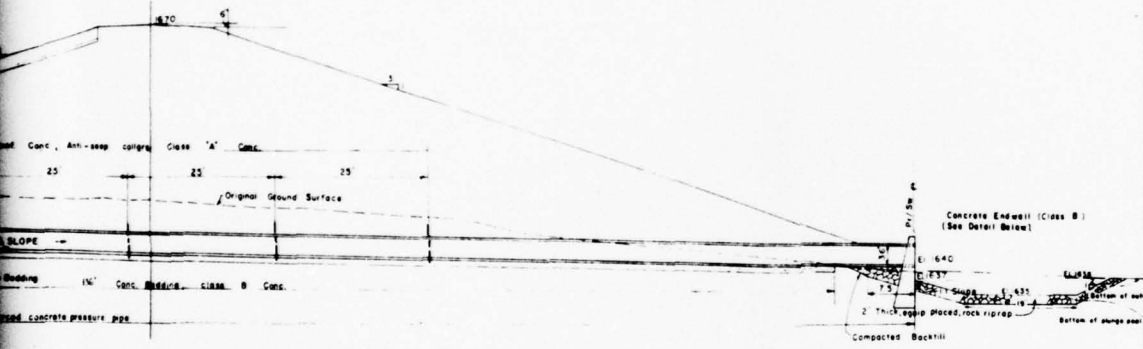
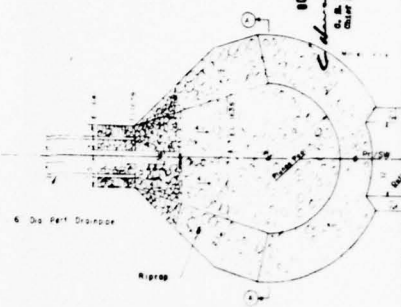
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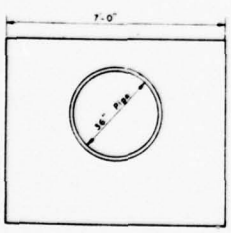
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PLAN VIEW
 1/2" = 10'



PROFILE ON PRINCIPAL SPILLWAY
 SCALE 1" = 10' HORIZONTAL 1" = 10' VERTICAL



SIDE VIEW

END WALL

PRINCIPAL SPILLWAY & PLUNGE POOL
 FOR
 GA LION BAY DAM
 MADE FOR
 TREASURE LAKE, INC.

R.M. KEDDAL AND ASSOCIATES, INC.
 Engineers, Planners and Surveyors
 3400 SOUTH PARK ROAD
 BETHEL PARK, PA

DATE JULY 1969
 REV AUG 1963
 [Signature]

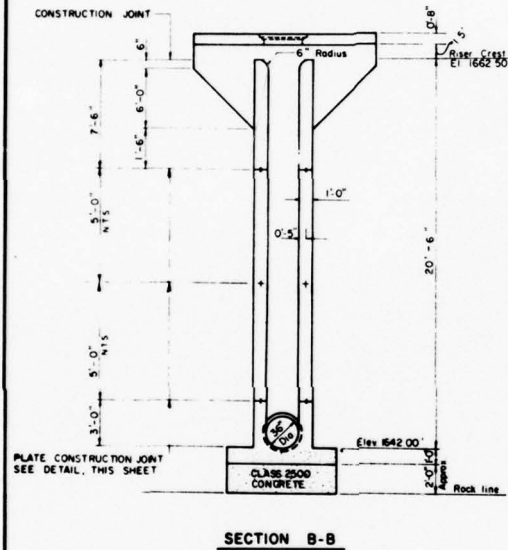
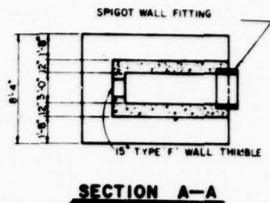
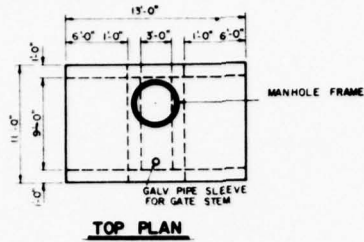
JOB NO 137
 SCALE AS SHOWN

JOHN ROBERT GALES PE

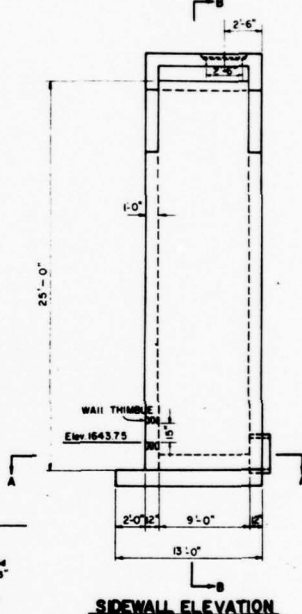
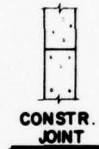
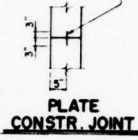
PLATE 6

D'APPOLONIA

DRAWN BY	ACS 5-22-79	CHECKED BY JEP	6-4-79	DRAWING NUMBER 76 07-B131



1/4" x 6" Steel Plate
Continuous Thru Constr Joint
Splices Shall Be Either
1. Butt Welded
2. Lapped 3" And Bolted
3. Lapped 3" And Fillet Welded



CONSTRUCTION DETAILS

Portland cement Type C10-S4, C150-S6 or C175-S6 Air Entraining shall be used

2 All Reinforcing Steel placed in Concrete placed against the ground shall have a minimum of 3" clear cover. All Reinforcing Steel placed in Concrete placed in forms shall have a minimum of 2" clear cover.

3 All exposed edges of concrete to have 1/4" chamfer unless otherwise noted.

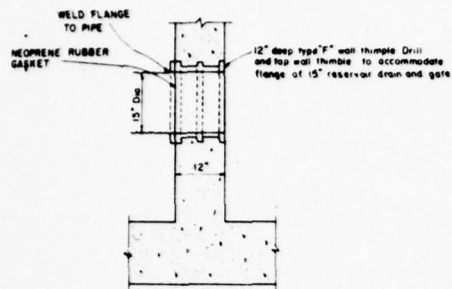
4 Bar dimensions are out to out of bar.

5 Radius of bends 1/4" 3 bar diam. for sizes 6, No. 7

SLUICE GATE NOTES

1 Armo model 55-10C flange back sluice gate with necessary stem guides.

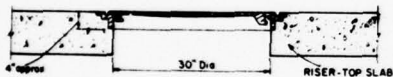
2 MB-24 Hand wheel lift.



RESERVOIR DRAIN WALL THIMBLE

MANHOLE ASSEMBLY

- The assembly shall be Gray Iron Casting 30" Dia opening.
- The lifting device shall consist of a 1" Dia hole, approx 3" from the outside perimeter of the lid.
- The locking device shall consist of a hook at one edge of the lid underside and a rotating bar with a lock bolt at the opposite edge.



STEEL SCHEDULE															
MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH	MARK	SIZE	QUANTITY	LENGTH	TYPE	B	C	TOTAL LENGTH
B1	6	17	7.10	1	---	---	120.7								
B2	6	8	12.6	1	---	---	100.8								
B3	6	26	8.9	21	3.7	5.2	227.6								
B4	6	8	12.6	1	---	---	100.8								
B5	6	12	7.10	1	---	---	85.2								
B6	6	8	3.0	1	---	---	24.0								
B7	6	4	6.1	21	1.0	5.1	24.4								
B8	6	2	6.1	21	1.0	5.1	12.2								
B9	6	16	6.1	21	1.0	5.1	97.6								
B10	6	2	6.1	21	1.0	5.1	12.2								
B11	6	8	4.8	1	---	---	77.4								
B12	6	4	3.2	1	---	---	12.8								
B13	6	14	7.6	21	3.0	7.6	107.0								
B14	6	4	7.11	21	0.5	7.6	31.9								
B15	6	4	1.9	21	0.5	7.6	31.0								
B16	6	2	8.7	21	1.1	7.6	17.2								
B17	6	3	2.5	1	---	---	6.9								
B18	6	3	2.5	1	---	---	6.9								
B19	6	6	2.0	1	---	---	12.0								

NOTE: Prior to Construction Contractor Must Submit Shop Drawings for Approval by the Engineer



JOHN ROBERT GALES PE

RISER DETAILS
FOR
GALION BAY DAM & WOLF CREEK DAM
MADE FOR
TREASURE * LAKE, INC.

NO SCALE

JULY 29, 1969

R.M. KEDDAL AND ASSOCIATES, INC.

Engineers, Planners and Surveyors
3400 SOUTH PARK ROAD
BETHEL PARK, PA.

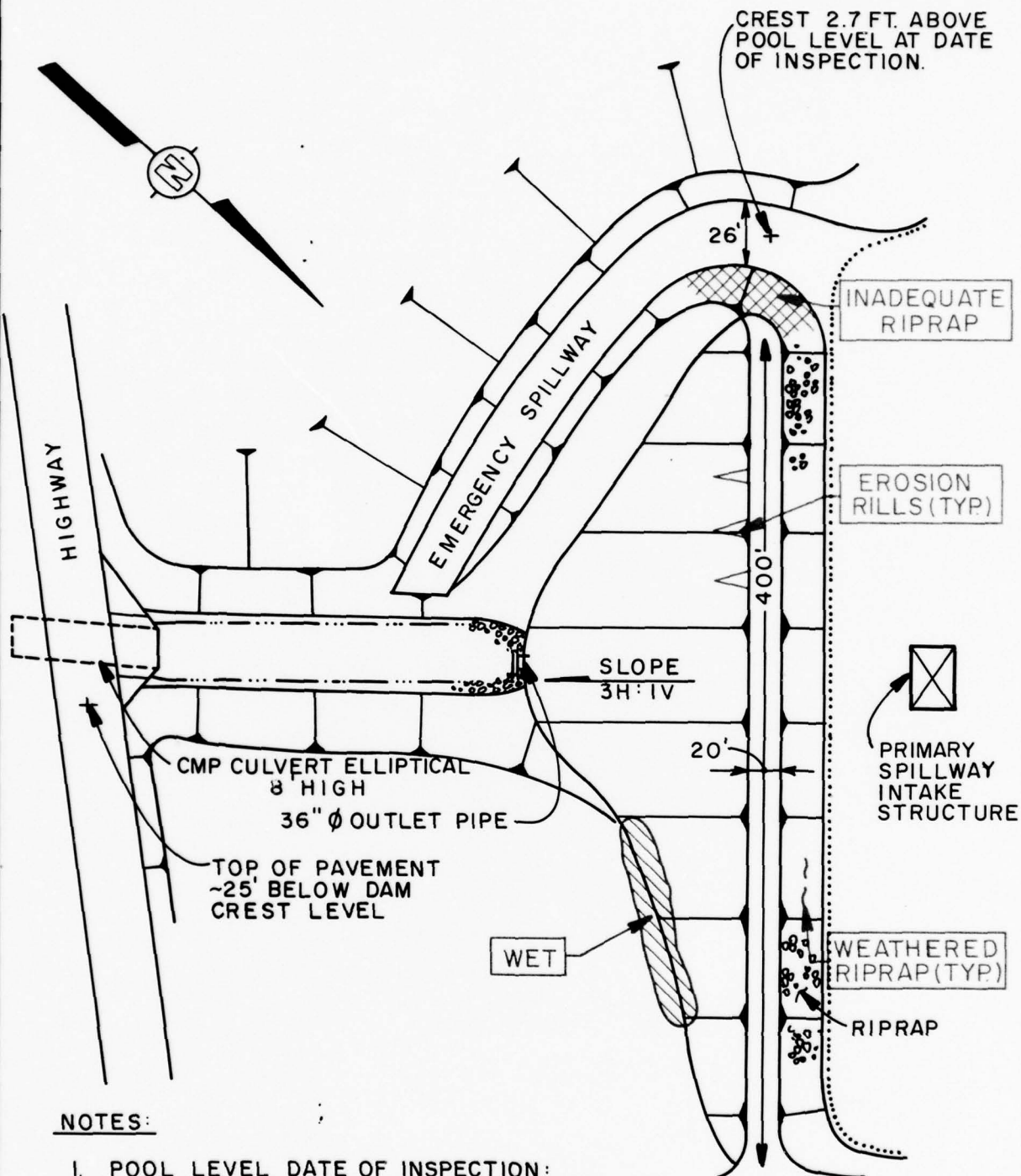
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REV AUG 1969
REV OCT 1969

PLATE 7

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	7-A28
5-7-79	5-7-79	6-4-79	DRAWING NUMBER
APPROVED BY	6-5-79		



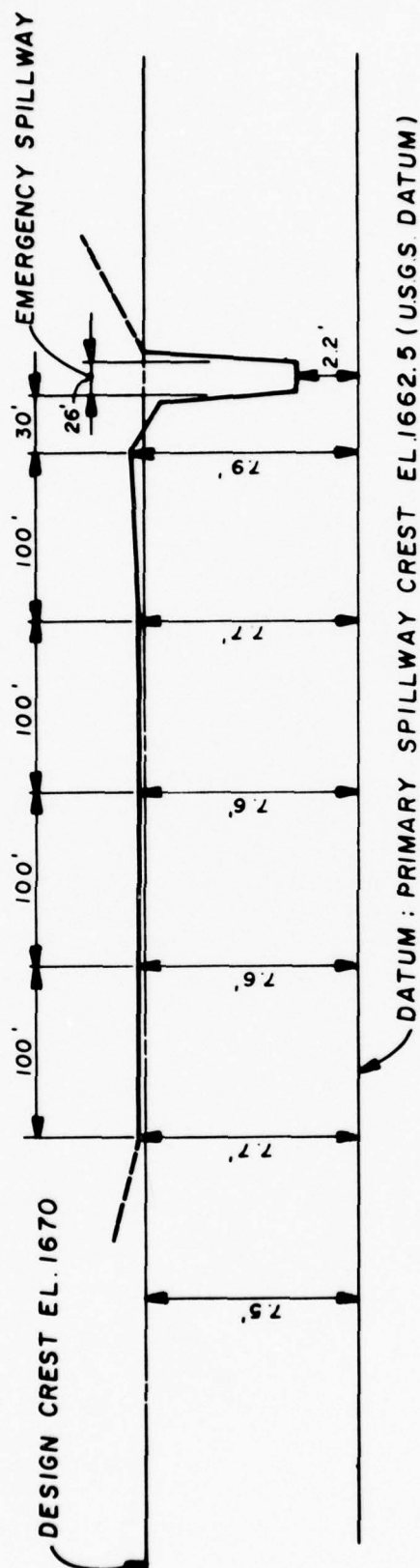
NOTES:

1. POOL LEVEL DATE OF INSPECTION:
~0.2 FT. ABOVE PRIMARY SPILLWAY CREST
2. EMERGENCY SPILLWAY FREEBOARD =
7.5 FT.

PLATE 8
GALION BAY DAM
GENERAL PLAN
FIELD INSPECTION NOTES
FIELD INSPECTION DATE: APR. 3, 79

D'APPOLONIA

DRAWN BY	ACS	CHECKED BY	BE	DRAWING NUMBER	78 57-A40
	6-28-79	APPROVED BY	<i>[Signature]</i>	737	



DAM CREST PROFILE
(LOOKING DOWNSTREAM)

NOTE:

DAM CREST IS SURVEYED RELATIVE TO PRIMARY SPILLWAY CREST LEVEL.

PLATE 9

GALION BAY DAM
DAM CREST SURVEY
FIELD INSPECTION DATE: APR. 3, 79

D'APOLONIA

APPENDIX A

CHECKLIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Gallion Bay Dam COUNTY Clearfield STATE Pennsylvania ID# NDI I.D. PA-746
 TYPE OF DAM Earth HAZARD CATEGORY High DER I.D. 17-107
 DATE(S) INSPECTION April 3, 1979 WEATHER Partly Cloudy TEMPERATURE 40s

POOL ELEVATION AT TIME OF INSPECTION 1662.5 M.S.L. TAILWATER AT TIME OF INSPECTION 1636+ M.S.L.

INSPECTION PERSONNEL:

Bilgin Erel

Wah-Tak Chan

REVIEW INSPECTION PERSONNEL:
(May 4, 1979)

E. D'Appolonia

L. D. Andersen

J. H. Poellot

Bilgin Erel

RECORDED BY Bilgin Erel

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Minor erosion rills at crest level near right abutment.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The crest of the dam is within 0.1 foot of the design crest level relative to the emergency spillway crest elevation.	
RIPRAP FAILURES	Riprap on the upstream slope has decomposed at certain locations. However, it still appears to be providing adequate erosion protection.	

VISUAL INSPECTION
PHASE I
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	No signs of distress.	
ANY NOTICEABLE SEEPAGE	A wet area at toe level near the left abutment. There is no perceivable seepage from this wet area.	
STAFF GAGE AND RECORDER	None.	
DRAINS	None.	

VISUAL INSPECTION
PHASE I
OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The outlet conduit was not accessible for inspection. Only the downstream end was visible. No distress was observed.	
INTAKE STRUCTURE	Visible portions are in good condition.	
OUTLET STRUCTURE	Riprapped plunge pool. In good condition.	
OUTLET CHANNEL	No obstructions in the outlet channel that would significantly affect discharge capacity of the outlet works.	
EMERGENCY GATE	Lake drawdown sluice gate was operated by maintenance personnel and was observed to be functional.	

VISUAL INSPECTION
PHASE I
UNCATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The emergency spillway has no concrete overflow structure.	
APPROACH CHANNEL	Trapezoidal earth channel. In good condition.	
DISCHARGE CHANNEL	Trapezoidal earth channel. Inadequate riprap on the embankment side of the channel.	Additional riprap should be provided at the embankment side of the emergency spillway discharge channel.
BRIDGE AND PIERS	None.	

VISUAL INSPECTION
 PHASE I
 GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A.	
APPROACH CHANNEL	N/A.	
DISCHARGE CHANNEL	N/A.	
BRIDGE PIERS	N/A.	
GATES AND OPERATION EQUIPMENT	N/A.	

VISUAL INSPECTION
PHASE I
INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	

VISUAL INSPECTION
PHASE I
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle to moderately steep. No significant shoreline erosion.	
SEDIMENTATION	Unknown.	
UPSTREAM RESERVOIRS	None.	

VISUAL INSPECTION
PHASE I
DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	There are no obstructions that would affect the discharge capacity of the outlet conduit.	
SLOPES	No apparent instability (immediately downstream from the dam).	
APPROXIMATE NUMBER OF HOMES AND POPULATION	The valley between Galion Bay and Gravel Lick dams (which is located 1/2 mile downstream) is uninhabited. However, it is estimated that failure of this dam would cause the failure of Gravel Lick Dam and combined discharge would cause large loss of life and property damage in DuBois.	

APPENDIX B

CHECKLIST

ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Galion Bay Dam

ID# NDI I.D. PA-746

DER I.D. 17-107

REMARKS	
ITEM	
AS-BUILT DRAWINGS	The drawings are available in the state files.
REGIONAL VICINITY MAP	See Plate 1.
CONSTRUCTION HISTORY	The dam was designed by R. M. Keddal and Associates, Inc., and Engineering Mechanics, Inc., of Pittsburgh, Pennsylvania, in 1969. The dam was constructed by Canton Development Company with completion in June 1971.
TYPICAL SECTIONS OF DAM	See Plate 3.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	See Plate 6.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
RAINFALL/RESERVOIR RECORDS	Not available.
DESIGN REPORTS	Galion Bay Dam for Treasure Lake of Pennsylvania, Inc., prepared by R. M. Keddal and Associates, Inc., Engineers and Surveyors, and Engineering Mechanics, Inc., Consulting Engineers (the report is undated).
GEOLOGY REPORTS	None prepared.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Hydrology and hydraulic calculations and some preliminary stability analyses for the embankment are included in the above-referenced design report. No reference to any detailed stability analysis was found.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	It appears that no formal materials investigation was performed. For the boring logs, see Plate 3.

**CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I**

ITEM	REMARKS
POST CONSTRUCTION SURVEYS OF DAM	None reported.
BORROW SOURCES	Unknown.
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	Not recorded.

CHECKLIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

ITEM	REMARKS
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None reported.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported.
MAINTENANCE OPERATION RECORDS	Not recorded.
SPILLWAY PLAN SECTIONS DETAILS	See Plate 2.
OPERATING EQUIPMENT PLANS AND DETAILS	See Plate 6.

CHECKLIST
ENGINEERING DATA
HYDROLOGIC AND HYDRAULIC

DRAINAGE AREA CHARACTERISTICS: 4.4 square miles (woodlands)
ELEVATION; TOP NORMAL POOL AND STORAGE CAPACITY: 1662.5 (3700 acre-feet)
ELEVATION; TOP FLOOD CONTROL POOL AND STORAGE CAPACITY: 1670 (6700 acre-feet)
ELEVATION; MAXIMUM DESIGN POOL: 1670
ELEVATION; TOP DAM: 1670

SPILLWAY:

- a. Elevation 1664.5
- b. Type Trapezoidal open channel
- c. Width 26 feet (as measured perpendicular to flow direction)
- d. Length Not applicable
- e. Location Spillover Adjacent to emergency spillway
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type 15-inch reservoir drainpipe, 36-inch reinforced concrete conduit
- b. Location At center of embankment
- c. Entrance Inverts 1642.8
- d. Exit Inverts 1629+
- e. Emergency Draindown Facilities 15-inch pipe

HYDROMETEOROLOGICAL GAGES:

- a. Type None
- b. Location None
- c. Records None

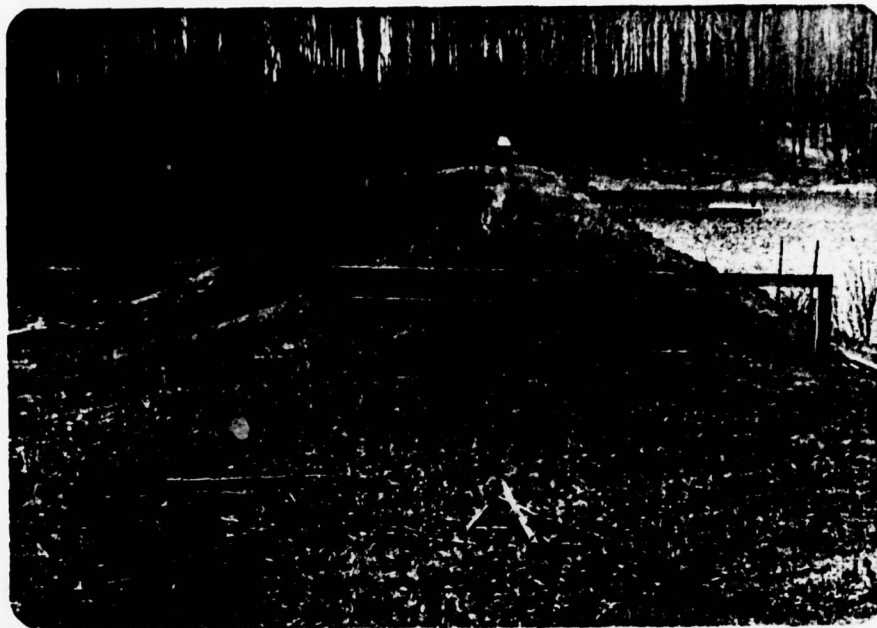
MAXIMUM NONDAMAGING DISCHARGE: Emergency spillway discharge capacity

LIST OF PHOTOGRAPHS
GALION BAY DAM
NDI I.D. NO. PA-747
APRIL 3, 1979

PHOTOGRAPH NO.

DESCRIPTION

- | | |
|---|--|
| 1 | Crest (looking west). Emergency spillway along far abutment. |
| 2 | Emergency spillway approach channel. |
| 3 | Inadequate riprap in emergency spillway against the embankment. |
| 4 | Primary spillway intake structure and outlet pipe sluice gate control. |
| 5 | Primary spillway discharge pipe. |
| 6 | Downstream dam. Gravel Lick Dam two miles downstream. |



Photograph No. 1

Crest (looking west). Emergency spillway along far abutment.



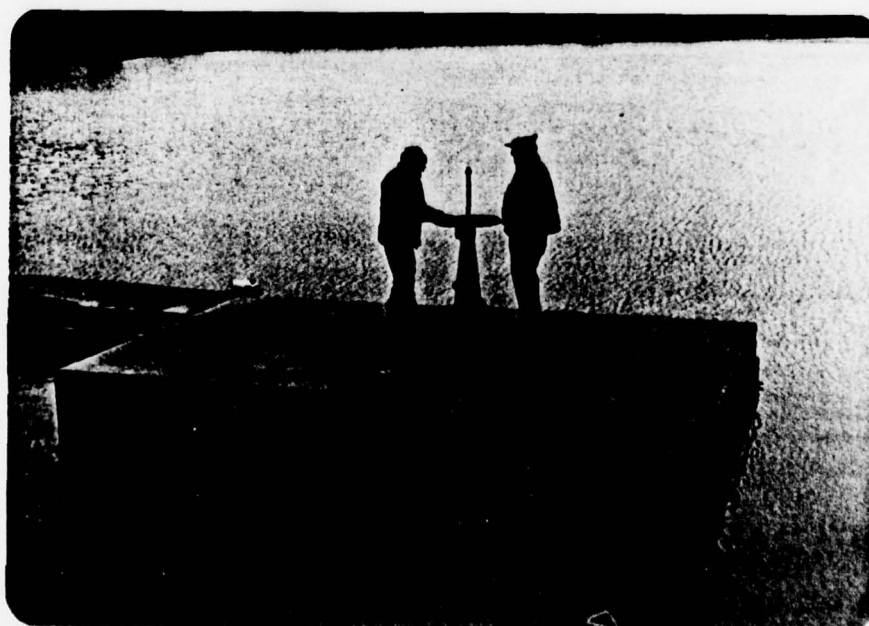
Photograph No. 2

Emergency spillway approach channel.



Photograph No. 3

Inadequate riprap in emergency spillway against the embankment.



Photograph No. 4

Primary spillway intake structure and outlet pipe sluice gate control.



Photograph No. 5
Primary spillway discharge pipe.



Photograph No. 6
Downstream dam. Gravel Lick Dam two miles downstream.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

OF DAM: Galion Bay Dam (NDI I.D. PA-747)

PROBABLE MAXIMUM PRECIPITATION (PMP) = 23.3 INCHES/24 HOURS⁽¹⁾

STATION	1	2	3	4	5
Station Description	Treasure Lake	Galion Bay Dam			
Drainage Area (square miles)	4.36	0			
Cumulative Drainage Area (square miles)	4.36	4.36			
Adjustment of PMF for Drainage Area (%) ⁽²⁾					
6 Hours	117	-			
12 Hours	127	-			
24 Hours	141	-			
48 Hours	151	-			
72 Hours	-	-			
Snyder Hydrograph Parameters					
Zone ⁽³⁾	24	24A	-		
C _p /C _t ⁽⁴⁾	0.45/1.6	0.45/4.2	-		
L (miles) ⁽⁵⁾	2.1	-	-		
L _{ca} (miles) ⁽⁵⁾	0.5	-	-		
t _p = C _t (L·L _{ca}) ^{0.3} (hours)	1.62	4.26	-		
Spillway Data ⁽⁶⁾		Pri- mary	Emer- gency		
Crest Length (ft)	-	18	26		
Freeboard (ft)	-	7.6	5.5		
Discharge Coefficient	-	-	-		
Exponent	-	-	-		

(1) Hydrometeorological Report 33 (Figure 1), U.S. Army, Corps of Engineers, 1956.

(2) Hydrometeorological Report 33 (Figure 2), U.S. Army, Corps of Engineers, 1956.

(3) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's Coefficients (C_p and C_t). Zone 24A was recommended by the COE. However, conservative Zone 24 was used.

(4) Snyder's Coefficients.

(5) L = Length of longest water course from outlet to basin divide.

L_{ca} = Length of water course from outlet to point opposite the centroid of drainage area.

(6) Flood discharge capacity was based on the combined capacity of the primary and emergency spillways of Wolf Creek Dam and Galion Bay Dam.

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
 FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
 AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS									
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9	
				.20	.30	.40	.50	.60	.70	.80	.90	1.00	
HYDROGRAPH AT	1	4.36	1	2170.	3255.	4340.	5425.	6510.	7596.	8681.	9766.	10851.	
	(11.29)	(61.45)	92.18)	122.90)	153.63)	184.36)	215.08)	245.81)	276.53)	307.26)	
ROUTED TO	2	4.36	1	279.	628.	1273.	1917.	2553.	3387.	4180.	4954.	5913.	
	(11.29)	(7.91)	17.77)	36.06)	54.29)	72.28)	95.91)	118.36)	140.28)	167.43)	

PLAN 1

RATIO OF PMF	ELEVATION STORAGE OUTFLOW	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM	TIME OF FAILURE HOURS
0.20	1664.87	1662.50	1662.50	1670.10	0.00
0.30	1665.88	1000.	1000.	4093.	0.00
0.40	1666.64	0.	0.	5497.	0.00
0.50	1667.33				0.00
0.60	1668.01				0.00
0.70	1668.62				0.00
0.80	1669.19				0.00
0.90	1669.75				0.00
1.00	1670.27				0.00

OVERTOPPING ANALYSIS SUMMARY

PAGE D4 of 4

D'APPOLONIA

CONSULTING ENGINEERS, INC.

By NLC Date 4-18-79 Subject LAKE RENE Sheet No. 1 of 1
 Chkd. By BE Date 4-19-79 SPILLWAY RATING Proj. No. 78-367-21

22
23

SPILLWAY RATING

{ TWO PRIMARY — 3' ϕ PIPE W/SCS RISER @ ELEV 1662.5 (1)
 { TWO EMERGENCY ROCK CUT SPILLWAYS { WOLF CREEK 130' @ 1665.2 (2)
 { GALION BAY 26' @ 1664.6 (3)

ELEVATION. (RESERVOIR)	WOLF CREEK COMBINED SPILLWAY CAPACITY, cfs	GALION BAY COMBINED SPILLWAY CAPACITY, cfs	TOTAL CAPACITY FOR TREASURG LAKE cfs
1662.5	0	0	0
1663	20	20	40
1663.5	56	56	112
1664.6	124	124	248
1665	138	157	295
1665.2	139	173	312
1666	392	294	686
1668	1792	743	2535
1670	3844 \leftarrow TOP OF DAM	1453 \leftarrow	5297 \leftarrow
1675	10933	4369	15302

NOTE: FIGURES BOUNDED UP TO NEAREST, CFS.

$$(1) \text{ PRIMARY SPILLWAYS } \begin{cases} Q = 3.1(2L)H^{3/2} & L=9' \therefore Q = 55.8 H^{3/2} \\ \text{for } 0 < H < 1.5' \\ Q = C_d A_b \sqrt{2gH} & L_b = 207' \quad C_d = 0.5 \\ = 28.5 H^{1/2} & \text{for } H \geq 1 \end{cases}$$

$$(2) \text{ WOLF CR. EMER. SPILLWAY } \quad Q = 2.7(130) H^{1.5}$$

$$(3) \text{ GALION BAY EMER. SPILLWAY } \quad Q = 2.7(26) H^{1.5}$$

APPENDIX E REGIONAL GEOLOGY

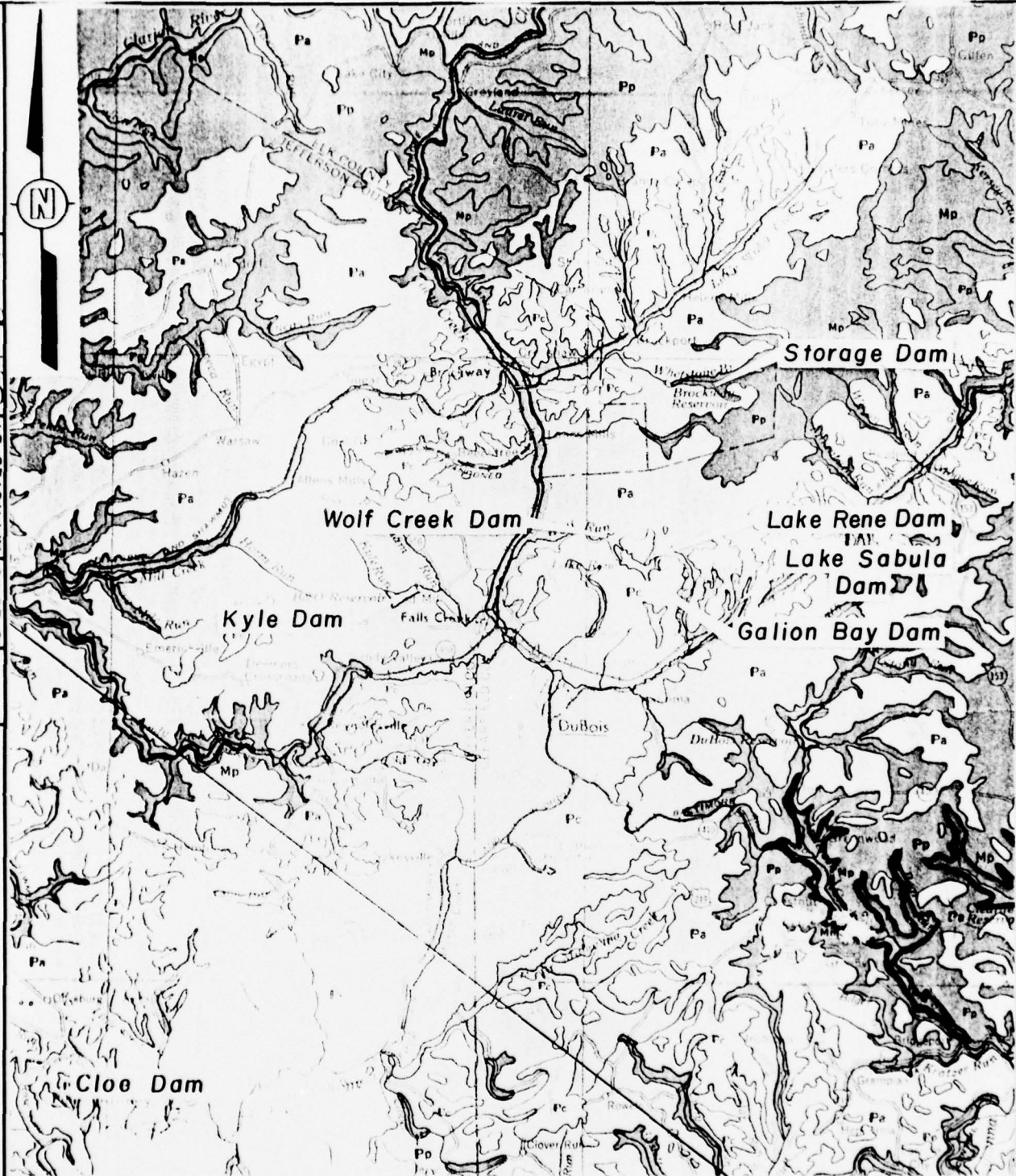
Galion Bay Dam is located on strata of the Conemaugh Formation (Pennsylvanian Age). The site lies along the northwest flank of the Punxsutawney-Caledonia Syncline. Strata in the area dip gently to the southeast at about 100 feet per mile.

The lower section of the Conemaugh Formation is characterized by interbedded sandstones, shales, claystones, and thin coal seams. The claystones are also known as redbeds and are prone to landslides.

Strip mining of the Upper Freeport coal, which lies at the base of the Conemaugh, has taken place west and northeast of the dam. Several potential coking coal seams of the Allegheny Formation (Pennsylvanian Age) lie beneath the site.

One major fault exists in the area and is located approximately two miles northeast of the site. This fault is known as the Mountain Run Fault and trends to the northeast along the southeastern flank of the Boone Mountain Anticline. Maximum displacement along the fault is estimated to be 400 feet.

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STORAGE, WOLF CREEK, KYLE,
LAKE RENE, LAKE SABULA,
GALION BAY AND CLOE DAM

GEOLOGY MAP

REFERENCE

GEOLOGIC MAP OF PENNSYLVANIA PREPARED
BY COMMONWEALTH OF PENNA. DEPT. OF INTERNAL
AFFAIRS, DATED 1960, SCALE 1" = 4 MILES

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PENNSYLVANIAN

APPALACHIAN PLATEAU

- Pm** Monongahela Formation
Cyclic sequences of sandstone, shale, limestone and coal; limestones prominent in northern outcrop areas; shale and sandstone increase southward; commercial coals present base at the bottom of the Pittsburgh Coal.
- Pc** Conemaugh Formation
Cyclic sequences of red and gray shales and siltstones with thin limestones and coals; massive Mahoning Sandstone commonly present at base; Ames Limestone present in middle of section; Brush Creek Limestone in lower part of section.
- Pa** Allegheny Group
Cyclic sequences of sandstone, shale, limestone and coal; numerous commercial coals; limestones thicken westward; Vanport Limestone in lower part of section includes Kierport, Kittanning, and Clarion Formations.
- Pp** Pottsville Group
Predominantly sandstones and conglomerates with thin shales and coals; some coals mineable locally.

ANTHRACITE REGION

- Ppp** Post-Pottsville Formations
Brown or gray sandstones and shales with some conglomerate and numerous mineable coals.
- Pp** Pottsville Group
Light gray to white, coarse grained sandstones and conglomerates with some mineable coals; includes Sharp Mountain, Schunkill, and Tumbling Run Formations.

MISSISSIPPIAN

- Mmc** Mauch Chunk Formation
Red shales with brown to greenish gray clayey sandstones; includes Greenbrier Limestone in Fayette, Westmoreland, and Somerset counties; Logansburg Limestone at the base in southwestern Pennsylvania.
- Mb** Pocono Group
Predominantly gray, hard, massive, cross-bedded conglomerate and sandstone with some shale; includes in the Appalachian Plateau Berwyn, Shenango, Cayahoga, Cassinaga, Corry, and Knapp Formations; includes part of "Onondaga" of M. E. Fuller in Potter and Tioga counties.

GEOLOGY MAP LEGEND

REFERENCE:

GEOLOGIC MAP OF PENNSYLVANIA PREPARED BY COMMONWEALTH OF PENNA. DEPT. OF INTERNAL AFFAIRS, DATED 1960, SCALE 1" = 4 MILES

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